What is claimed is:

1. Apparatus for use in a base station in an orthogonal frequency division multiplexing (OFDM) based spread spectrum multiple access wireless system comprising:

a sequence generator for generating one or more pilot tone hopping sequences each including pilot tones, said pilot tones each being generated at a prescribed frequency and time instants in a prescribed time-frequency grid; and

a waveform generator, responsive to said one or more pilot tone hopping sequences, for generating a waveform for transmission.

2. The invention as defined in claim 1 wherein each of said one or more pilot tone hopping sequences is a Latin Squares based pilot tone hopping sequence.

3. The invention as defined in claim 1 wherein said sequence generator generates each of said one or more pilot tone hopping sequences in accordance with $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$.

4. The invention as defined in claim 3 wherein said sequence generator generates each of said one or more pilot tone hopping sequences having a prescribed time periodicity.

5. The invention as defined in claim 4 wherein said time periodicity includes a prescribed number of symbol intervals.

6. The invention as defined in claim 5 wherein said waveform generator includes a transmitter for transmitting said pilot tones in said time periodicity.

7. The invention as defined in claim 3 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "T", "a", "s_i" and "d" are integer constants, "p" is a prime constant, and "Z" is a permutation operator.

8. The invention as defined in claim 7 wherein said prescribed number of symbol intervals T is a prime number.

9. The invention as defined in claim 7 wherein each of said one or more pilot tone hopping sequences generated includes a prime number of distinct tones.

10. The invention as defined in claim 7 wherein said permutation operator Z is defined on $[\text{MIN}\ (0,\ d),\ \text{MAX}\ (N_t-1, p-1+d)]$ and "N_t" is the total number of tones in the system, p is a prime number of tones and "d" is a prescribed frequency.

11. The invention as defined in claim 7 wherein each of said one or more pilot tone hopping sequences has a prescribed slope "a".

12. The invention as defined in claim 11 wherein said slope "a" is unique to said base station among one or more neighboring base stations.

13. The invention as defined in claim 1 wherein said waveform generator generates a waveform in accordance with $\sum_{i=1}^{N_{pil}} C_k^{S_i} e^{2\pi f_k^{S_i} \Delta f t}$, where $f_k^{S_i}$ are given by the sequence $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$, Δf is the basic frequency spacing between adjacent tones, $C_k^{S_i}$ is a known symbol to be transmitted at the k^{th} symbol instant and tone $f_k^{S_i}$.

14. The invention as defined in claim 13 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "T", "a", "s_i" and "d" are integer constants, "p" is a prime constant, and "Z" is a permutation operator.

15. The invention as defined in claim 1 wherein said waveform generator generates a waveform in accordance with $\sum_{i=1}^{N_{pil}} C_k^{S_i} \Gamma_k^{S_i} e^{2\pi f_k^{S_i} \Delta f t}$, where $f_k^{S_i}$ are given by the sequence $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$, Δf is the basic frequency spacing between adjacent tones, $C_k^{S_i}$ is a known symbol to be transmitted at the k^{th} symbol instant and tone $f_k^{S_i}$, and $\Gamma_k^{S_i} = 1$, if $f_k^{S_i} \in [0, N_t - 1]$, and $\Gamma_k^{S_i} = 0$, otherwise.

16. The invention as defined in claim 15 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "T", "a", "s_i" and "d" are integer constants, "p" is a prime constant, and "Z" is a permutation operator.

17. The invention as defined in claim 16 wherein said waveform generator includes a transmitter for transmitting said pilot tones and wherein pilot tones in phantom tone regions defined by $[\text{MIN}\ (0,\ d),\ 0]$ and $[N_t - 1,\ \text{MAX}\ (N_t - 1, p - 1 + d)]$, where

"N_t" is the total number of tones in the system, p is a prime number of tones and "d" is a prescribed frequency, are not transmitted.

18. A method for use in a base station in an orthogonal frequency division multiplexing (OFDM) based spread spectrum multiple access wireless system comprising the steps of:

generating one or more pilot tone hopping sequences each including pilot tones, said pilot tones each being generated at a prescribed frequency and time instants in a prescribed time-frequency grid; and

in response to said one or more pilot tone hopping sequences, generating a waveform for transmission.

19. The method as defined in claim 18 wherein each of said one or more pilot tone hopping sequences is a Latin Squares based pilot tone hopping sequence.

20. The method as defined in claim 18 wherein said step of generating one or more pilot tone hopping sequences includes a step of generating each of said one or more pilot tone hopping sequences in accordance with $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$.

21. The method as defined in claim 20 wherein said step of generating one or more pilot tone hopping sequences includes a step of generating each of said one or more pilot tone hopping sequences having a prescribed time periodicity.

22. The method as defined in claim 21 wherein said time periodicity includes a prescribed number of symbol intervals.

23. The method as defined in claim 22 further including a step of transmitting said pilot tones in said time periodicity.

24. The method as defined in claim 20 wherein $f_k^{S_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "T", "a", "s_i" and "d" are integer constants, "p" is a prime constant, and "Z" is a permutation operator.

25. The method as defined in claim 24 wherein said prescribed number of symbol intervals T is a prime number.

26. The method as defined in claim 24 wherein said step of generating one or more pilot tone hopping sequences includes a step of generating each of said one or more pilot tone hopping sequences having a prime number of distinct tones.

27. The method as defined in claim 24 wherein said permutation operator Z is defined on [MIN $(0, d)$, MAX $(N_t - 1, p - 1 + d)$] and "N_t" is the total number of tones in the system, p is a prime number of tones and "d" is a prescribed frequency.

28. The method as defined in claim 24 wherein said step of generating one or more pilot tone hopping sequences includes a step of generating each of said one or more pilot tone hopping sequences having a prescribed slope "a".

29. The method as defined in claim 28 wherein said slope "a" is unique to said base station among one or more neighboring base stations.

30. The method as defined in claim 18 wherein said step of generating said waveform includes a step of generating said waveform in accordance with $\sum_{i=1}^{N_{pil}} C_k^{S_i} e^{2\pi f_k^{S_i} \Delta f t}$, where $f_k^{S_i}$ are given by the sequence $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$, where Δf is the basic frequency spacing between adjacent tones, $C_k^{S_i}$ is a known symbol to be transmitted at the k^{th} symbol instant and tone $f_k^{S_i}$.

31. The method as defined in claim 30 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "T", "a", "s_i" and "d" are integer constants, "p" is a prime constant and "Z" is a permutation operator.

32. The method as defined in claim 18 wherein said step of generating said waveform includes a step of generating said waveform in accordance with $\sum_{i=1}^{N_{pil}} C_k^{S_i} \Gamma_k^{S_i} e^{2\pi f_k^{S_i} \Delta f t}$, where $f_k^{S_i}$ are given by the sequence $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$, where Δf is the basic frequency spacing between adjacent tones, $C_k^{S_i}$ is a known symbol to be transmitted at the k^{th} symbol instant and tone $f_k^{S_i}$, and $\Gamma_k^{S_i}$ = 1, if $f_k^{S_i} \in [0, N_t - 1]$, and $\Gamma_k^{S_i}$ = 0, otherwise.

33. The method as defined in claim 32 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "T", "a", "s_i" and "d" are integer constants, "p" is a prime constant, and "Z" is a permutation operator.

34. The method as defined in claim 33 further including a step of transmitting said pilot tones and wherein pilot tones in phantom tone regions defined by [MIN $(0, d)$, 0] and [$N_t - 1$, MAX $(N_t - 1, p - 1 + d)$], where "N_t" is the total number of tones in the system, p is a prime number of tones and "d" is a prescribed frequency are not transmitted.

35. Apparatus for use in a base station in an orthogonal frequency division multiplexing (OFDM) based spread spectrum multiple access wireless system comprising:

means for generating one or more pilot tone hopping sequences each including pilot tones, said pilot tones each being generated at a prescribed frequency and time instants in a prescribed time-frequency grid; and

means, responsive to said one or more pilot tone hopping sequences, for generating a waveform for transmission.

36. The invention as defined in claim 35 wherein each of said one or more pilot tone hopping sequences is a Latin Squares based pilot tone hopping sequence.

37. The invention as defined in claim 35 wherein said step of generating one or more pilot tone hopping sequences includes a step of generating each of said one or more pilot tone hopping sequences in accordance with $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$.

38. The invention as defined in claim 37 wherein said means for generating one or more pilot tone hopping sequences includes means for generating each of said one or more pilot tone hopping sequences having a prescribed time periodicity.

39. The invention as defined in claim ~~38~~ wherein said time periodicity includes a prescribed number of symbol intervals.

40. The invention as defined in claim 39 further including means for transmitting said pilot tones in said time periodicity.

41. The invention as defined in claim 37 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "*T*", "*a*", "s_i" and "*d*" are integer constants, "*p*" is a prime constant, and "*Z*" is a permutation operator.

42. The invention as defined in claim 41 wherein said prescribed number of symbol intervals *T* is a prime number.

43. The invention as defined in claim 41 wherein said means for generating one or more pilot tone hopping sequences includes means for generating each of said one or more pilot tone hopping sequences having a prime number of distinct tones.

44. The invention as defined in claim 41 wherein said permutation operator *Z* is defined on [MIN (*0, d*), MAX ($N_t - 1, p + 1 + d$)] and "N_t" is the total number of tones in the system, *p* is a prime number of tones and "*d*" is a prescribed frequency.

45. The invention as defined in claim 41 wherein said means for generating one or more pilot tone hopping sequences includes means for generating each of said one or more pilot tone hopping sequences having a prescribed slope "a".

46. The invention as defined in claim 45 wherein said slope "a" is unique to said base station among one or more neighboring base stations.

47. The invention as defined in claim 35 wherein said means for generating said waveform includes means for generating said waveform in accordance with $\sum_{i=1}^{N_{pil}} C_k^{S_i} e^{2\pi f_k^{S_i} \Delta f t}$, where $f_k^{S_i}$ are given by the sequence $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for $i = 1, \cdots N_{pil}$, where Δf is the basic frequency spacing between adjacent tones, $C_k^{S_i}$ is a known symbol to be transmitted at the k^{th} symbol instant and tone $f_k^{S_i}$.

48. The invention as defined in claim 47 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "*T*", "*a*", "s_i" and "*d*" are integer constants, "*p*" is a prime constant, and "*Z*" is a permutation operator.

49. The invention as defined in claim 35 wherein said means for generating said waveform includes means for generating said waveform in accordance with $\sum_{i=1}^{N_{pil}} C_k^{S_i} \Gamma_k^{S_i} e^{2\pi f_k^{S_i} \Delta f t}$, where $f_k^{S_i}$ are given by the sequence $S_i = \{f_0^{S_i}, f_1^{S_i}, \cdots f_k^{S_i}, \cdots\}$, for

$i = 1, \cdots N_{pil}$, where Δf is the basic frequency spacing between adjacent tones, $C_k^{S_i}$ is a known symbol to be transmitted at the k^{th} symbol instant and tone $f_k^{S_i}$, and $\Gamma_k^{S_i} = 1$, if $f_k^{S_i} \in [0, N_t - 1]$, and $\Gamma_k^{S_i} = 0$, otherwise.

A3 cont

50. The invention as defined in claim 49 wherein $f_k^{s_i} = Z\{(a(k \bmod T) + s_i) \bmod p + d\}$, where "k" is a time instant index, "T", "a", "s_i" and "d" are integer constants, "p" is a prime constant, and "Z" is a permutation operator.

51. The invention as defined in claim 50 further including means for transmitting said pilot tones and wherein pilot tones in phantom tone regions defined by [MIN $(0, d)$, 0] and [$N_t - 1$, MAX $(N_t - 1, p - 1 + d)$], where "N_t" is the total number of tones in the system, p is a prime number of tones and "d" is a prescribed frequency are not transmitted.